

CLAIMS

We claim:

1. An apparatus for preparing, measuring, and feeding a catalyst slurry to a polymerization reactor, wherein the apparatus comprises:

a mixing tank for mixing a catalyst slurry comprising a solid catalyst in a liquid medium;

a storage tank for maintaining the catalyst slurry, wherein the storage tank is fluidly connected to receive the catalyst slurry from the mixing tank;

a pump for delivering the catalyst slurry from the storage tank to a polymerization reactor through a fluid passage;

a flow meter adapted to measure the flow of the catalyst slurry through the fluid passage; and

a controller that receives a flow signal from the flow meter indicative of the flow of the catalyst slurry, wherein the controller directs the pump to adjust the flow of the catalyst slurry based on the flow signal.

2. The apparatus of claim 1, wherein the mixing tank includes at least one agitator.

3. The apparatus of claim 1, wherein the storage tank includes at least one agitator.

4. The apparatus of claim 1, wherein the mixing tank is at a higher elevation than the storage tank so that the catalyst slurry flows from the mixing tank to the storage tank at least partially due to gravity.

5. The apparatus of claim 1, wherein the catalyst slurry flows from the mixing tank to the storage tank due to a pressure differential between the mixing tank and the storage tank.

6. The apparatus of claim 1, further comprising a second storage tank, wherein the second storage tank is fluidly connected to receive the catalyst slurry from the mixing tank and is fluidly connected to provide the catalyst slurry to the polymerization reactor.

7. The apparatus of claim 1, further comprising a level indicator for measuring the level of catalyst slurry in the storage tank, wherein the controller is adapted to receive a signal indicative of the measured level of the catalyst slurry in the storage tank and, when the level of the catalyst slurry in the storage tank is below a predetermined level, the controller directs the catalyst slurry to the storage tank from the mixing tank.

8. The apparatus of claim 1, further comprising a pneumatic device upstream of the mixing tank, wherein the pneumatic device is adapted to provide a pneumatic gas to the mixing tank.

9. A polymerization apparatus comprising:
a slurry polymerization reactor having at least one catalyst feed;
a mixing tank for mixing a catalyst slurry comprising a solid catalyst in a liquid medium;
a storage tank for maintaining the catalyst slurry, wherein the storage tank is fluidly connected to receive the catalyst slurry from the mixing tank;
a pump for delivering the catalyst slurry from the storage tank through a fluid passage to the at least one catalyst feed of the polymerization reactor;
a flow meter measure the flow of the catalyst slurry into the reactor; and
a controller that receives a flow signal from the flow meter indicative of the flow of the catalyst slurry, wherein the controller directs the pump to adjust the flow of the catalyst slurry into the polymerization reactor based on the flow signal.

10. The polymerization apparatus of claim 9 wherein the slurry polymerization reactor has a plurality of catalyst feeds spaced to facilitate even distribution of the catalyst.

11. The polymerization apparatus of claim 9 further comprising a pneumatic catalyst transport system adapted to transport catalyst into the mixing tank.

12. An apparatus for monitoring and feeding a catalyst slurry, wherein the apparatus comprises:

a storage tank for the catalyst slurry, the storage tank having disposed therein an agitator;

a pump for delivering the catalyst slurry from the storage tank through a fluid passage;

a flow meter that measures a flow of the catalyst slurry through the fluid passage; and

a controller that receives a signal indicating the measured flow from the flow meter and signals the pump to adjust the flow of the catalyst slurry.

13. The apparatus of claim 12, wherein the controller calculates an amount of catalyst that has flowed over a unit of time through the fluid passage and signals the pump based on the calculated amount.

14. The apparatus of claim 12, further comprising a diluent feed fluidly connected to the fluid pump, such that the pump is capable of delivering a diluent rather than the catalyst slurry.

15. The apparatus of claim 12, further comprising a pneumatic device upstream of the mixing tank.

16. A polymerization apparatus comprising:

a slurry polymerization reactor having at least one catalyst feed,
a storage tank for the catalyst slurry, the storage tank having disposed therein an agitator;
a pump for delivering the catalyst slurry from the storage tank by a fluid passage to the at least one catalyst feed of the slurry polymerization reactor;
a flow meter that measures a flow of the catalyst slurry into the polymerization reactor; and
a controller that receives a signal indicating the measured flow from the flow meter and signals the pump to adjust the flow of the catalyst slurry into the slurry polymerization reactor.

17. The polymerization apparatus of claim 16 wherein the slurry polymerization reactor has a plurality of catalyst feeds spaced to facilitate even distribution of the catalyst in the polymerization reactor.

18. An apparatus for preparing and continuously feeding a catalyst slurry to a polymerization reactor, wherein the apparatus comprises:
a first run tank having disposed therein an agitator and a level indicator;
a second run tank having disposed therein an agitator and a level indicator;
a pump connected to receive catalyst slurry from at least one of the first and second run tank and provide catalyst slurry to the polymerization reactor; and
a controller that receives signals from the level indicators and determines which run tank provides the catalyst slurry to the polymerization reactor.

19. The apparatus of claim 18, further comprising a mixing tank that mixes the catalyst slurry, the mixing tank being fluidly connected to deliver the catalyst slurry to each of the run tanks.

20. The apparatus of claim 19, wherein the controller is adapted to determine which run tank receives the catalyst slurry from the mixing tank.

21. The apparatus of claim 18, further comprising:
 - a fluid passage that extends from the pump to the polymerization reactor; and
 - a flow meter adapted to measure the flow of the catalyst slurry into the polymerization reactor;
 - wherein the controller receives a signal indicating the measured flow from the flow meter and sends a signal to the pump to adjust the flow of the catalyst slurry into the polymerization reactor.
22. A process for preparing a catalyst slurry and providing the catalyst slurry to a polymerization reaction zone, wherein the process comprises:
 - forming a catalyst slurry from a dry catalyst and a liquid medium;
 - maintaining the catalyst slurry at an essentially homogeneous solids-to-liquid ratio;
 - pumping the catalyst slurry into the polymerization reaction zone;
 - measuring the flow of the catalyst slurry pumped into the polymerization reaction zone; and
 - altering the flow of the catalyst slurry pumped into the polymerization reaction zone at least partially in response to the measured flow.
23. A process according to claim 22, further comprising continuously agitating the catalyst slurry to maintain the catalyst slurry at an essentially homogeneous solid-to-liquid ratio prior to pumping the catalyst slurry into the reaction zone.
24. A process according to claim 22, comprising pumping a liquid diluent in place of the catalyst slurry into the reaction zone.
25. A process according to claim 24, further comprising resuming pumping catalyst slurry into the reaction zone.
26. A process according to claim 22, comprising:

determining the amount of the catalyst fed to the reaction zone over a selected period; and

altering the flow of the catalyst slurry into the reaction zone at least partially in response to the determined amount.

27. A process according to claim 22, further comprising operating the polymerization reaction zone to produce solid polymer particles.

28. A process according to claim 22, further comprising transporting the dry catalyst into the mixing zone by pneumatic transport.

29. A process for continuously providing a catalyst slurry to a polymerization zone, wherein the process comprises:

introducing a dry catalyst and a liquid medium into a mixing tank to form a catalyst slurry;

feeding the catalyst slurry to a storage tank;

continuously agitating the catalyst slurry in the storage tank so as to maintain the catalyst slurry at an essentially homogeneous solid-to-liquid ratio; and

continuously pumping the catalyst slurry into the reaction zone.

30. The process of claim 29 wherein the reaction zone has a plurality of catalyst feeds spaced to facilitate even distribution of the catalyst.

31. The process according to claim 29, further comprising monitoring the amount of the catalyst slurry pumped into the reaction zone, and continuously altering the flow rate of the catalyst slurry pumped into the reaction zone in response to the monitored amount.

32. A process according to claim 29, further comprising agitating the catalyst slurry with one or more impellers in the mixing tank to maintain the catalyst slurry at an essentially homogeneous solid-to-liquid ratio.

33. A process according to claim 29, further comprising operating the reaction zone to produce solid polymer particles.

34. A process according to claim 29, further comprising transporting the dry catalyst into the mixing zone by pneumatic transport.

35. A process for continuously feeding catalyst slurry to a polymerization reaction zone, wherein the process comprises:

preparing a catalyst slurry of solid catalyst and a liquid medium;

maintaining the catalyst slurry in a plurality of tanks at an essentially homogeneous solids-to-liquid ratio; and

pumping the catalyst slurry from at least a first one of the tanks into the reaction zone.

36. A process according to claim 35, further comprising:

detecting the amount of catalyst slurry in the first tank; and

automatically switching to a second one of the tanks when the amount in the first tank is at a predetermined level.

37. A process according to claim 35, comprising simultaneously introducing the catalyst slurry from the plurality of tanks at a plurality of locations along the reaction zone.

38. A process according to claim 35, wherein two types of catalyst are fed to the polymerization reaction zone.

39. A process according to claim 35, further comprising operating the polymerization reaction zone to produce solid polymer particles.

40. The process of claim 35 wherein the reaction zone has a plurality of catalyst feeds spaced to facilitate even distribution of the catalyst.

41. The process of claim 35 wherein the plurality of tanks are maintained at a lower pressure than the reaction zone.

42. A process according to claim 35, further comprising transporting the dry catalyst into the mixing zone by pneumatic transport.